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(71) Applicant *(for all designated States except US)*: NUOVA PANSAC S.P.A. [IT/IT]; Viale Francesco Restelli, 5, I-20124 Milano (IT).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LORI, Fabrizio [IT/IT]; Strada Romana, 44, I-46030 Cerese di Virgilio (IT). BORTOLETTO, Graziano [IT/IT]; Via Pietro Micca, 5, I-31059 Zero Branco (IT).

(74) Agent: PREMRU, Rok; Via De Amicis, 4, I-20052 Monza (IT).

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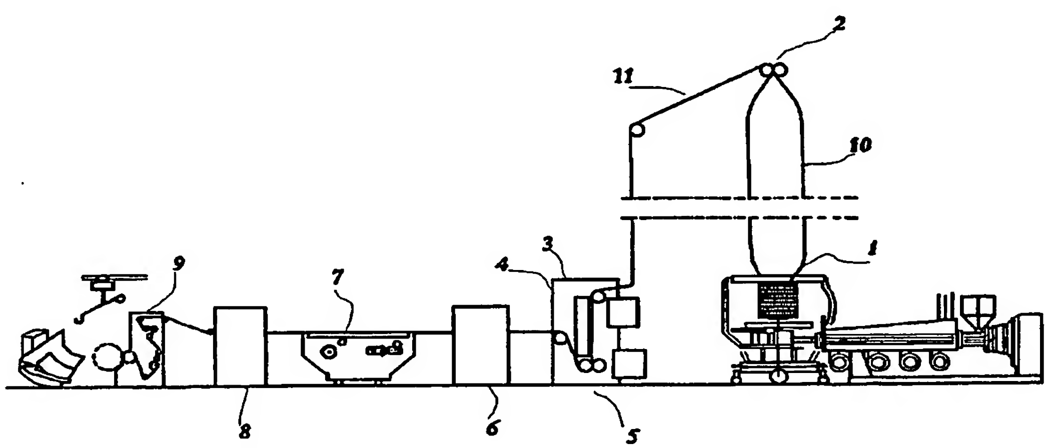
(54) Title: APPARATUS AND METHOD FOR PRODUCING A POLYOLEFINIC TRANSPIRING FILM



(57) Abstract: The invention relates to a method and a plant for producing polyolefinic transpiring films by means of bubble extrusion of a charged LLDPE mix, flattening of the extruded tubular in order to obtain a flat film and transversal and/or longitudinal stretching of the flat film.

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APPARATUS AND METHOD FOR PRODUCING A POLYOLEFINIC TRANSPIRING FILM

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The present invention relates to an apparatus and method for producing a polyolefinic transpiring film, capable of allowing vapour and air to pass therethrough while being impermeable to liquids.

The patent EP 0.283.200 B1, to which reference is made for a general view of the prior art, describes a method for producing transpiring films in which a linear polyethylene extrusion at low density (LLDPE), charged with $CaCO_3$, is first heat-embossed, for providing reduced thickness imprints, and then stretched to obtain a transpiring film with a particularly elevated transpirability in the reduced thickness zones.

Transpiring films according to the prior art moreover have various problems and drawbacks.

One problem which is encountered in known polyolefinic transpiring films is the possible formation of micro-holes during the stretching phase of the film, which formation is due to the presence of impurities, in particular oxidised and carbonised particles.

Such impurities may already be present in the mix to be extruded, or they may form during the extrusion process of the polyethylene.

The micro-holes, which have an average diameter between 0.2 and 2 mm, may compromise the liquid impermeability characteristics; such risk increases with the speed of the stretching process and with the increase in the degree of stretching of the film.

Another problem which is encountered in polyolefinic transpiring films is the non-uniformity of the transpirability.

A principle aim of the present invention is to provide a method and an apparatus for producing a polyolefinic transpiring film which allow to overcome at least part of the above cited problems.

Such aim is obtained by means of a method in accordance with the claim 1 and by means of a plant in accordance with claim 4.

Further embodiments of the method may be carried out in accordance with the dependent claims 2 and 3, and further embodiments of the plant may be carried out in accordance with the dependent claims 5 and 6.

The method and the apparatus according to the invention will appear in a clear manner from the following description of one possible embodiment, provided in a purely indicative manner, together with the drawing figure which shows, in a schematic view, a manufacturing plant in accordance with the invention.

The present method provides for the use of a mix preferably of linear polyethylene at low density (LLDPE) charged with a base of $CaCo_3$.

Alternatively, it is possible to use linear polyethylene at low density (LLDPE) or polyethylene at medium density (MDPE).

It is also possible to use copolymers of polyethylene having α-olefin with 4-10 atoms of carbon (1 butene, 1 pentene, 1 esene, 1 eptene, 1 ottene, 4 metil, 1 pentene).

Naturally, it is also possible to use other types of charges, organic or inorganic, having dimensions between 0.6 and 6 μm and treated in a way to render their surfaces hydrophopic.

In particular, it is possible to use: clay, kaolin, zeolite, Zn, Al, Ca, $CaSO_4$, $BaSO_4$, MgO, $Mg(OH)_2$, TiO_2.

The quality of the added charge depends also on the degree of desired traspirability, normally the charge constitutes from 30% to 70% by weight of the mix.

Such mix is bubble-extruded (so-called blow moulding), by means of a circular-head extruder 1 in order to obtain a tubular 10.

The temperature of the tubular exiting from the extruder 1 is between 150-230°C and, preferably, between 170-190°C.

The ratio of expansion of the tubular 10 may vary between 1:2 and 1:4, and preferably is 1:3.

One characteristic of the method of the present invention is the fact that the extruded and expanded tubular 10 is subjected to a calendering operation.

In detail, the tubular 10 enters, at a temperature of about 80-100°C, in a first calender 2 where it is compressed and stretched into the form of a sheet 11, constituted by two superimposed layers, assuming a width equal to half of the circumference of the tubular and a thickness which is double with respect to the thickness of the tubular.

Such characteristic has the advantage of resolving the problem of insufficient liquid impermeability due to the micro-holes which may form in the films during the stretching phase: it is in fact extremely improbable that both the layers of the film are damaged at the same point.

The calender 2 used for flattening the tubular 10 comprises a pair of smooth coupled rollers of which the first one is chromed steel and the second one is rubber with a hardness of 60-80 shore; the pressure supplied by the calander 2 on the flattened tubular 10 varies between 5 and 10 kg/cm2.

A second characteristic of the method according to the invention consists in the fact that after having been flattened, the film 11 is heated up to a softening temperature.

Such temperature depends on the type of mix which is extruded, in the case of an LLDPE base mix it may vary between 80 and 130 °C and usually, it is around about 100 °C.

The heating executed in this manner favours the removal of humidity or of additives present in the mix which have a low evaporation point.

Moreover, the heating executed in this manner favours the elimination of micro-stresses present in the film due to the preceding phases of the method and favours the homogenisation of the internal structure of the film.

In order to obtain the heating, the film 11 is first made to run on heated rollers 3, having a temperature of about 60-70 °C, and then made to pass near infrared ray lamps 4 which further increase the temperature up to the point of softening.

In fact the use only of the heated rollers - normally heated with water or oil - does not allow to reach the softening temperature, or at least with great difficulty.

Moreover, the infrared lamps provide the advantage of also strongly heating the layer of air about the film 11 (typically up to 300-400 °C) which therefore permits to completely eliminate the residual humidity still present on the film 11.

A third characteristic of the method according to the invention consists in the fact that the film heated in this manner is further calandered by a calender 5 and, thereafter, cooled to a temperature between 8 and 30 °C.

Such cooling is carried out, preferably, through contact by means of one of the rollers of the calander 5, which is maintained at a constant temperature between 8 and 30 °C.

The further calendering permits, through the compression provided by the rollers, to intimately unite the two original layers so as to avoid the risks of de-lamination of the film produced in this manner, and the thermal shock to which the film is subjected permits to block the stabilisation process.

It is also possible, in this phase, to carry out an embossing operation of the film for a purely aesthetic purpose which does not modify the weight of the film.

It has been found that the thermal shock to which the film is subjected allows to obtain an improved transpirability during the successive stretching operations.

The compression of the film is obtained by coupling a chromed-steel roller coupled with a rubber roller (hardness 60-80 shore).

Successively to the process of sterilisation, the film 11 is subjected to transverse and/or longitudinal stretching.

For such purpose, there are present appropriate means 6 adapted to carry out the transversal stretching and appropriate means 8 adapted to carry out the longitudinal stretching.

In the illustrated example, the film 11 is subjected first to a transversal stretching and then to a longitudinal stretching: naturally these phases may also be inverted.

Preferably between the transversal stretching means 6 and the longitudinal stretching means 8 there are provided tentering means 7 for eliminating the folds created by the first process of stretching.

Normally, the ratio of longitudinal stretching varies between 1:1.5 and 1:2.5.

Also in this manner, the ratio of longitudinal stretching varies, usually, between 1:1.5 and 1:2.5.

However, if required, the ratio of stretching may also arrive to a ratio of 1:4.

At the end of the stretching phase, the film 11 may undergo further working steps or be wound up by an appropriate winding machine 9.

CLAIMS

1. Method for producing polyolefinic transpiring films comprising the steps of:

bubble extruding a mix of charged LLDPE:

flattening the tubular (10) in order to obtain a flat film (11);

transversal and/or longitudinal stretching of the flat film (11).

2. Method, according to claim 1, wherein, before the stretching step, there are provided the further steps of:

heating the flat film (11) up to a softening temperature;

compressing the flat film (11);

cooling the flat film to a temperature between 8-30 °C.

3. Method, according to claim 2, wherein the flat film (11) is first heated by conduction and successively by irradiation.

4. Plant for producing a stretched polyolefinic film comprising, in succession:

a bubble extruder (1);

a first calender (2) adapted to flatten the extruded tubular;

means (6) adapted to transversally stretch the film and/or means (8) adapted to longitudinally stretch the film.

5. Plant, according to claim 4, further comprising, before the transversal (6) and/or the longitudinal (8) stretching means, in succession:

means (3,4) adapted to heat the flat film (11) up to a softening temperature;

a second calender (5) adapted to compress the heated film;

means (5) adapted to quickly cool the film up to a temperature comprised between 8-30 °C.

6. Plant, according to claim 4 or 5, wherein said means adapted to heat the flat film (11) comprise, in succession:

first heating means, adapted to heat the film by conduction; and

second heating means adapted to heat the film by irradiation.

AMENDED CLAIMS
[received by the International Bureau on 7 March 2001 (07.03.01);
original claims 1-6 replaced by new claims 1-4 (1 page)]

1. Method for producing polyolefinic transpiring films comprising the steps of:

- bubble extruding a mix of charged LLDPE;
- flattening the tubular (10) in order to obtain a flat film (11);
- heating the flat film (11) up to a softening temperature;
- compressing the flat film (11);
- cooling the flat film to a temperature between 8-30 °C; and
- transversal and/or longitudinal stretching of the flat film (11).

2. Method, according to claim 1, wherein the flat film (11) is first heated by conduction and successively by irradiation.

3. Plant for producing a stretched polyolefinic film comprising, in succession:

- a bubble extruder (1);
- a first calender (2) adapted to flatten the extruded tubular;
- means (3,4) adapted to heat the flat film (11) up to a softening temperature;
- a second calender (5) adapted to compress the heated film;
- means (5) adapted to quickly cool the film up to a temperature comprised between 8-30 °C;
- means (6) adapted to transversally stretch the film and/or means (8) adapted to longitudinally stretch the film.

4. Plant, according to claim 3, wherein said means adapted to heat the flat film (11) comprise, in succession:

first heating means, adapted to heat the film by conduction; and

second heating means adapted to heat the film by irradiation.

Statement under Article 19(1)

New claim1 comprises the subject matter of original claim 1 and original claim 2.

New claim 2 corresponds to original claim 3.

New claim 3 comprises the subject matter of original claim 4 and original claim 5.

New claim 4 corresponds to original claim 6.

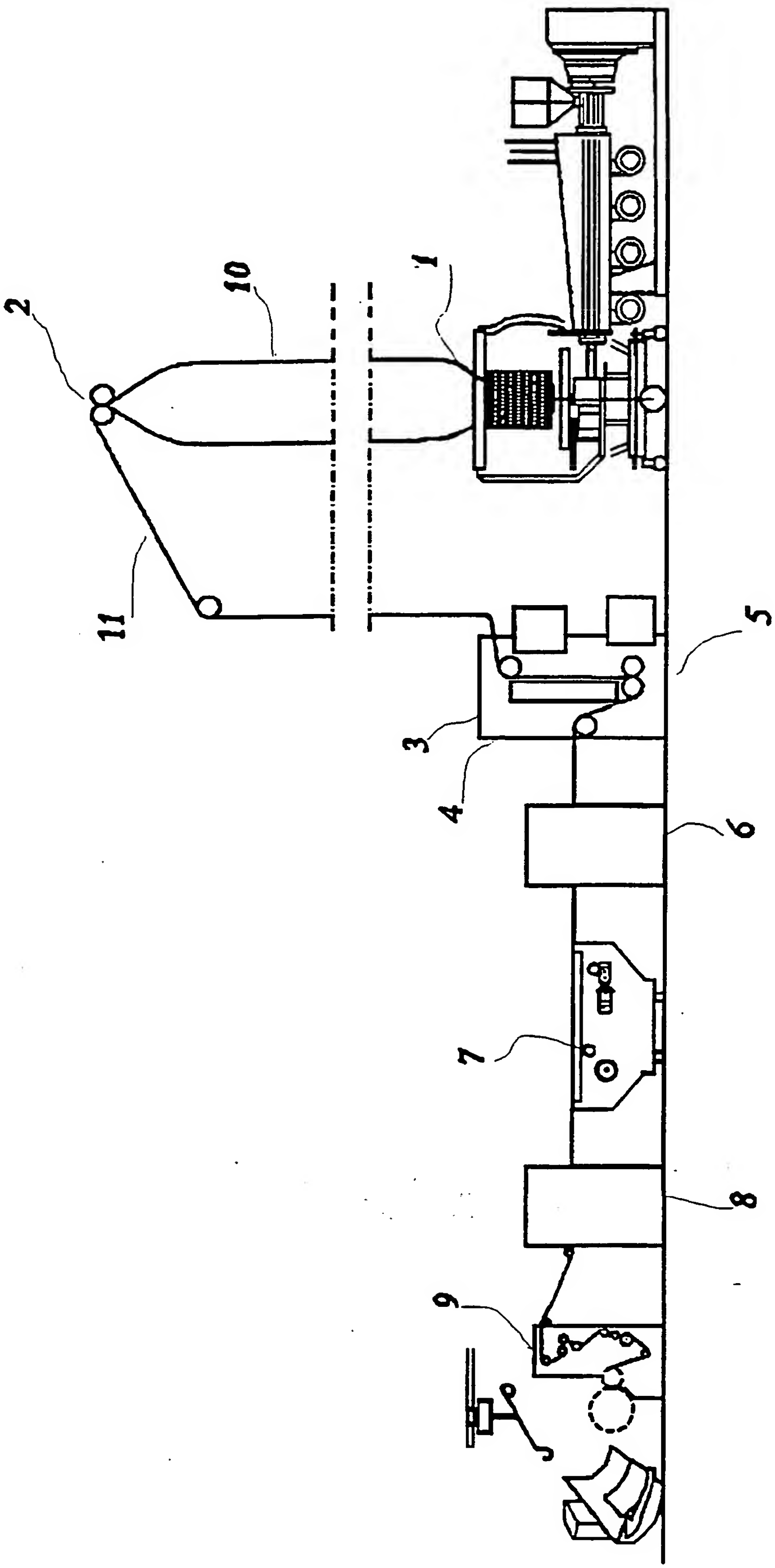

Fig. 1

INTERNAT AL SEARCH REPORT

Int· ional Application No
PCT/IB 00/01572

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B29C47/00 B29C55/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 363 937 A (KAO CORP) 18 April 1990 (1990-04-18) embodiment 2; page 5, line 32 - line 44; figure 1; tables 1,3	1,4,6
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 February 2001	21/02/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Attalla, G

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INTERNATIONAL SEARCH REPORT

International Application No
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